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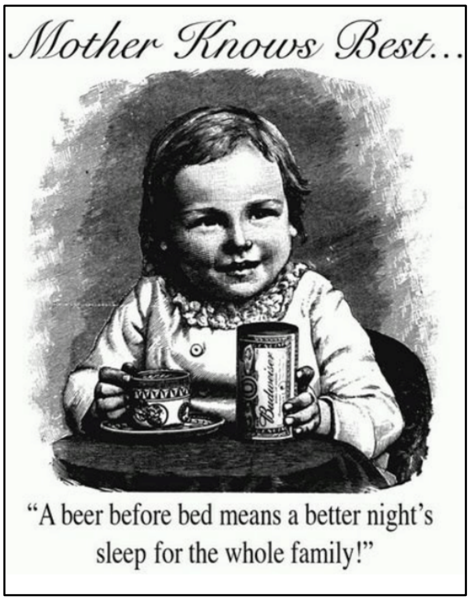
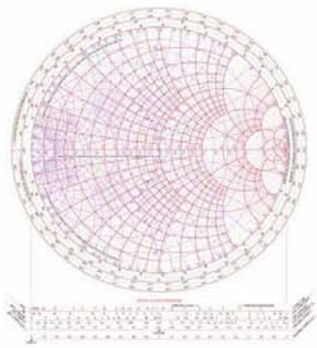
Christmas Lunch Meeting
1.00 pm Start
Saturday 4th December
Biralee Tavern

97-99 Melrose Drive Wodonga

Please RSVP by 5pm Friday November 19th so table numbers can be confirmed
Club pays for all meals and it's a great afternoon.
RSVP to secretary@nevarc.org.au right now to book your place



Smith Charts and stuff from VK3WS Bob Ayton & edited by VK2ER Graham Ayton – in the process of studying VNA (possible errors and omissions accepted).



We are spoilt these days with the low cost VNA (Vector Network Analyser) type devices available. A handful of years ago you would have to pay many thousands of dollars to purchase the cheapest VNA s on the market. Still now, a high quality VNA in its basic 2 port form such as: *from Rhode & Schwarz ZVL6-.com cost $48,702.72 (inc GST) and this unit is a PC based device with frequency range of 50KHz to 6 GHz.*

Or is little brother ZVL3.com for ($40,960.13 **Inc. GST) This one only goes to 3 GHz maximum.**

now you can buy  *one of these for around + or - $100!*

They can provide  *workable results up to approximately 3 GHz.*

SO.... What can we do with these? What can we expect from them? Why so cheap? Hmmm.... the answer to this question has a typical analogy.... *Why buy a Rolls Royce when a Mini Minor will get me "there" just as "well"?*

So... don't expect the cheapie to do "everything" the same as those above... but will it do "all I need it to do in my Ham Radio Hobby?" ...

I think you could be pleasantly surprised!

A whole bunch of "new terminology" suddenly appears, some of which you may have knowledge but others will be unfamiliar or previously avoided due to the complexity involved in its understanding... MATHs I've forgotten or was never interested enough in... and I got buy?

We all know about VSWR and there are lots of myths and misleading information about "swerring in an antenna" (*YUK... I hate that expression!*) but do you know about ***Return Loss?*** What about ***"S Parameters" S11 S21 etc?*** ... and ... ***SMITH CHARTS?*** *who is he (when he is home)?*

Your latest little toy... the **NanoVNA** and a little home work (*like watching some of the excellent uTube videos will answer most of your questions (such as **W2AEW**'s:* https://www.youtube.com/watch?v=F17mN5uuzGY&list=PL4ZSD4omd_AylEyNCQYR3RcEb0olukPEJ).

OK... What are "S Parameters? .... a simple explanation: *Scattering parameters or S-parameters (the elements of a scattering matrix or S-matrix) describe the electrical behavior of linear electrical networks when undergoing various steady state stimuli by electrical signals. i.e.: refers to the way in which the traveling currents and voltages in a transmission line are affected when they meet a discontinuity caused by the insertion of a network into the transmission line. This is equivalent to the wave meeting an impedance differing from the line's characteristic impedance.*

The mathematics becomes complex because we are dealing with "complex numbers" which have not only magnitude but also direction/Phase. So, 1+1 no longer simply equals 2 but complex phase angle calculations are included. But fortunately.... our little NanoVNA toy saves us from admitting we cannot handle that MATHs... it does it all and shows pretty pictures as well!

Port 1 *refers to the* ***S11*** *parameters and* ***port 2*** *refers to* ***S22*** *parameters but* ***S12*** *and* ***S21*** *require* ***port 1*** *and* ***port 2*** *(hence a 2 port VNA)*

S11 ***Return loss*** *of infinite dB is equivalent to a* ***VSWR*** *of* **1:1**.... *(i.e.: all of the travelling RF wave is transmitted at the antenna and no part of the RF wave is reflected back to the transmitter. The load impedance is exactly the same as the characteristic impedance of the transmission line as seen by the transmitting device.)*

Formula:

$$VSWR = \frac{1+10^{\frac{-RL}{20}}}{1-10^{\frac{-RL}{20}}}$$

Where RL = Return Loss

S11 *Return loss of* ***20.83dB*** *is equivalent to a* ***VSWR*** *of* **1.2** *(1.2:1)* **VSWR of 2:1 is an S11 of approx 9.5dB** So a high S11 number in dB is a good result... an **S11** result of **20dB** or higher means that the VSWR is less than 1.2 to 1. Most modern transceivers with an inbuilt "automatic Tuner" can usually compensate for VSWR of up to 3:1 (because of load impedance seen by the transmitter) as other than 50 ohms. It is this mismatch of LOAD IMPEDANCE (seen by the transmitter looking into the transmission line (coax) that determines the VSWR).

NOT the length of transmission line. ***Transmission lines can affect the impedance seen by the transmitter <u>but do not change the VSWR</u>*** *(ignoring faults and imperfections in the transmission line)*

Let's define a few terms

Parameter	Understanding
Resistance	*Linear value of resistance to electrical current measured in OHMs R=V/I*
Impedance	*Complex resistance to electrical current including the reactive effects of capacitors and/or inductors in the network also measured in OHMs Z = V/I +/-(jX)*
Characteristic Impedance	*referred to transmission lines either parallel wire:* $z_0 = 276/k^{-2}\log d/r$ where k *is the relative permittivity of the material between the conductors, d is distance apart and r is the radius of the conductor. .or for coaxial cable:* $Z_0 = 138/k^{-2}\log d_1/d_2$ *where d1 and d2 are outside and inside diameters of conductors. k for air = 1.00058986±0.00000050*
Reactance	**Reactance** (X) is defined as the opposition to the flow of current from a circuit element due to its inductance and/or capacitance. *Steady electric currents flowing along conductors in one direction undergo opposition (called electrical resistance), but no reactance. The unit of reactance is similar to the unit of resistance and impedance. The reactance is measured in* ***Ohm*** *(Ω).* X_c *is* ***Capacitive Reactance,*** X_L is ***Inductive Reactance Total*** $X = X_c + X_L$ ***Ohm***
Conductance	**electrical conductance**, (**G**) measures the ease with which an electric current pass. It is the reciprocal of resistance and used to have the unit "mho" but now is measured in "siemens" (**S**) **G = I/V** or the reciprocal of R i.e.: **G = 1/R**

Resistivity	Resistivity is commonly represented by the Greek letter ρ (rho). The SI unit of electrical resistivity is the ohm-meter (Ω·m). For example, if a 1 m solid cube of material has sheet contacts on two opposite faces, and the resistance between these contacts is 1 Ω, then the resistivity of the material is 1 Ω·m.
Conductivity	**Electrical conductivity** or **specific conductance** is the reciprocal of electrical resistivity. It represents a material's ability to conduct electric current. It is commonly signified by the Greek letter σ (sigma), but κ (kappa) (especially in electrical engineering) and γ (gamma) are sometimes used. The SI unit of electrical conductivity is siemens per metre (S/m).
Admittance	Admittance (symbolized Y) is an expression of the ease with which alternating current (AC) flows through a complex circuit or system. Admittance is a vector quantity comprised of two independent Scalar phenomena: conductance and susceptance . Admittance is the vector sum of conductance and susceptance. Susceptance is conventionally multiplied by the positive square root of -1, the unit imaginary number symbolized by j , to express Y as a complex quantity $G - jB_L$ (when the net susceptance is inductive) or $G + jB_C$ (when the net susceptance is capacitive).
Susceptance	Susceptance, denoted B , is an expression of the readiness with which an electronic component, circuit, or system releases stored energy as the current and voltage fluctuate. Susceptance is expressed in imaginary number siemens. It is observed for AC, but not for DC. When AC passes through a component that contains susceptance, energy might be stored and released in the form of a magnetic field, in which case the susceptance is inductive (denoted $-jB_L$), or energy might be stored and released in the form of an electric field, in which case the susceptance is capacitive (denoted $+jB_C$).
Return Loss	The definition of return loss is that it is **the loss of power in the signal returned / reflected by a discontinuity in a transmission line** or optical fibre. This is normally expressed in decibels. In other words, if all the power was transferred to the load, then there would be an infinite return loss. Return loss is in dB and is **always positive**. **S11**, in dB, is **always negative**. While the two terms are related as ***S11[dB]***

	= -RL, **they are not the same**, and their behaviors are opposite. If we always referred to **S11** as **reflection coefficient**, everyone would always understand our meaning; **See table below showing the relationship between Return loss vs VSWR vs Reflection Coefficient**
Insertion Loss	We express **insertion loss in dB** (decibels), and ordinarily, it is a positive number since it indicates how much signal loss by comparing the input power to the output power. In summary, a signal will always come out lesser than their input level. Furthermore, the lower the number equals a better insertion loss performance; for example, an insertion loss of 0.3dB is better than 0.5dB.
Reflection Coefficient	**the reflection coefficient describes how much of a wave is reflected by an impedance discontinuity in the transmission medium. It is equal to the ratio of the amplitude of the reflected wave to the incident wave, with each expressed as** phasors. **Reflection coefficient is closely associated with VSWR indicating the portion of the signal that is reflected at the end of a feeder, etc.** The Greek letter Γ **is typically used for** reflection coefficient, **although σ is also often seen. If voltage of forward and reflected waves are known then $\Gamma = V\text{ref}/V\text{fwd}$.** It is also possible to express the reflection coefficient in terms of the load and line or feeder impedances or it can also be calculated using power differences: $\Gamma = P_{Ref}^{-2}/P_{FWD}^{-2}$ and because it is a "comparison" between 2 parameters of the same type, no units apply ... the result is one number relative to another. example: if the reflected power was half the forward power i.e.: $P_{REFLECTED}$ = 1/2 of $P_{FORWARD}$ then **Γ =** 0.7071 *The reflection coefficient is different to the VSWR. The reflection coefficient is a figure that quantifies the level of the incident waveform that is reflected, whereas the standing wave ratio, be it a current standing wave ratio or a voltage standing wave ratio looks at the ratio of the peak and minimum voltage or current levels within the feeder arising from the forward and reflected power.*

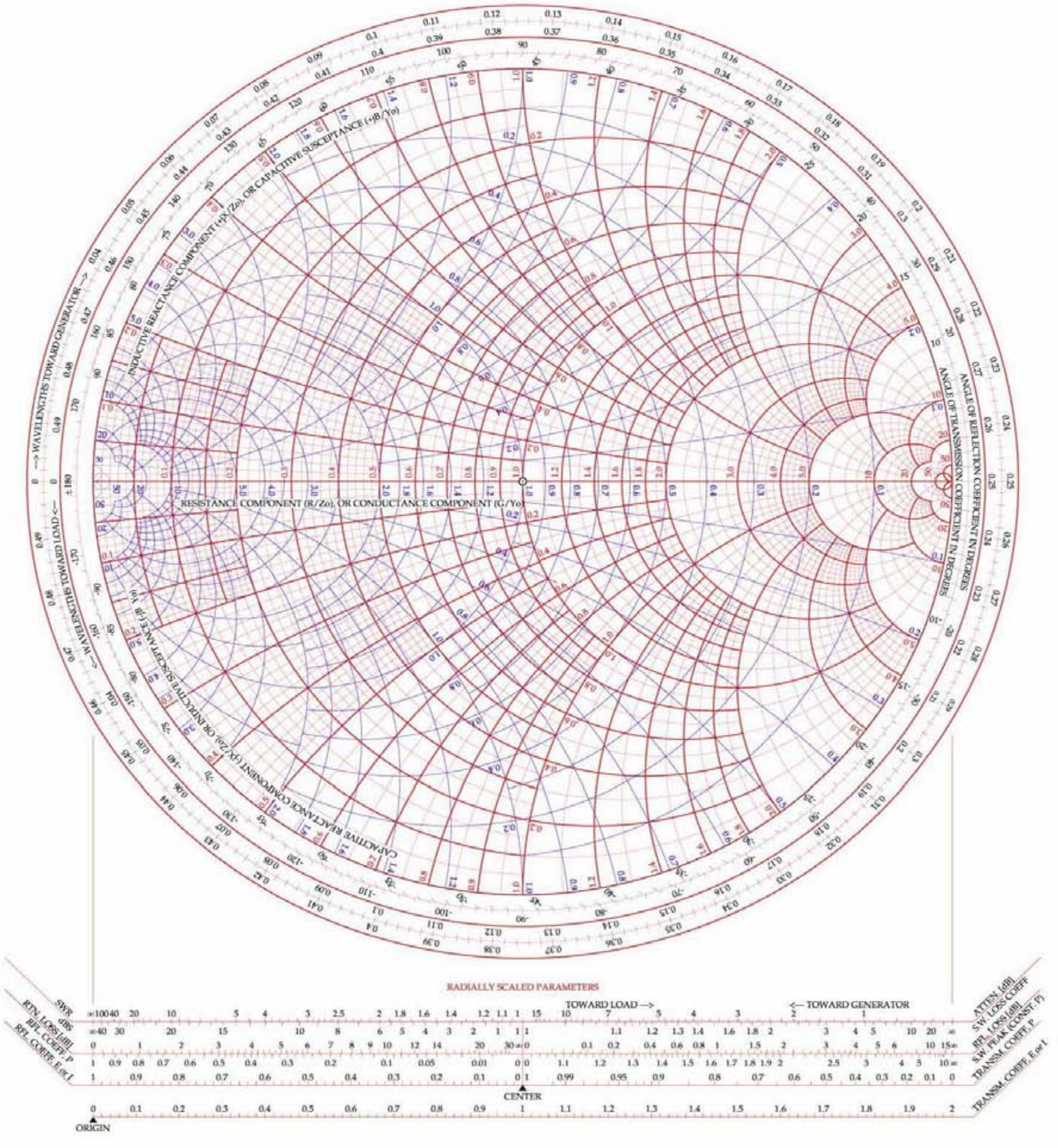
VSWR	The **VSWR** or voltage standing wave ratio applies specifically to the voltage standing waves that are set up on a feeder or transmission line. As it is easier to detect the voltage standing waves, and in many instances, voltages are more important in terms of device breakdown, the term VSWR is often used, especially within RF design areas. **SWR** describes the voltage and current standing waves that appear on the line. It is a generic description for both current and voltage standing waves.

VSWR to Return Loss and Return Loss to VSWR

Return loss (db)	VSWR	Voltage Reflection Coefficient
1	17.391	0.891
2	8.724	0.794
3	5.848	0.708
4	4.419	0.631
5	3.570	0.562
6	3.010	0.501
7	2.615	0.447
8	2.323	0.398
9	2.100	0.355
10	1.925	0.316
11	1.785	0.282
12	1.671	0.251
13	1.577	0.224
14	1.499	0.200
15	1.433	0.178
16	1.377	0.158
17	1.329	0.141
18	1.288	0.126
19	1.253	0.112
20	1.222	0.100
21	1.196	0.089
22	1.173	0.079
23	1.152	0.071
24	1.135	0.063
25	1.119	0.056
26	1.105	0.050
27	1.094	0.045
28	1.083	0.040
29	1.074	0.035
30	1.065	0.032

Now it is time to look at the Smith CHART.

The **Smith Chart** is a fantastic tool for visualizing the impedance of a transmission line and antenna system as a function of frequency. Smith Charts can be used to increase understanding of transmission lines and how they behave from an impedance viewpoint. Smith Charts are also extremely helpful for **impedance matching**. Smith Charts were originally developed around 1940 by Phillip Smith as a useful tool for making the equations involved in transmission lines easier to manipulate. To sum up, the Smith Chart is a plot of the reflection coefficient. Since the reflection coefficient corresponds directly to an impedance, we are actually plotting the impedance of a device on the Smith Chart.



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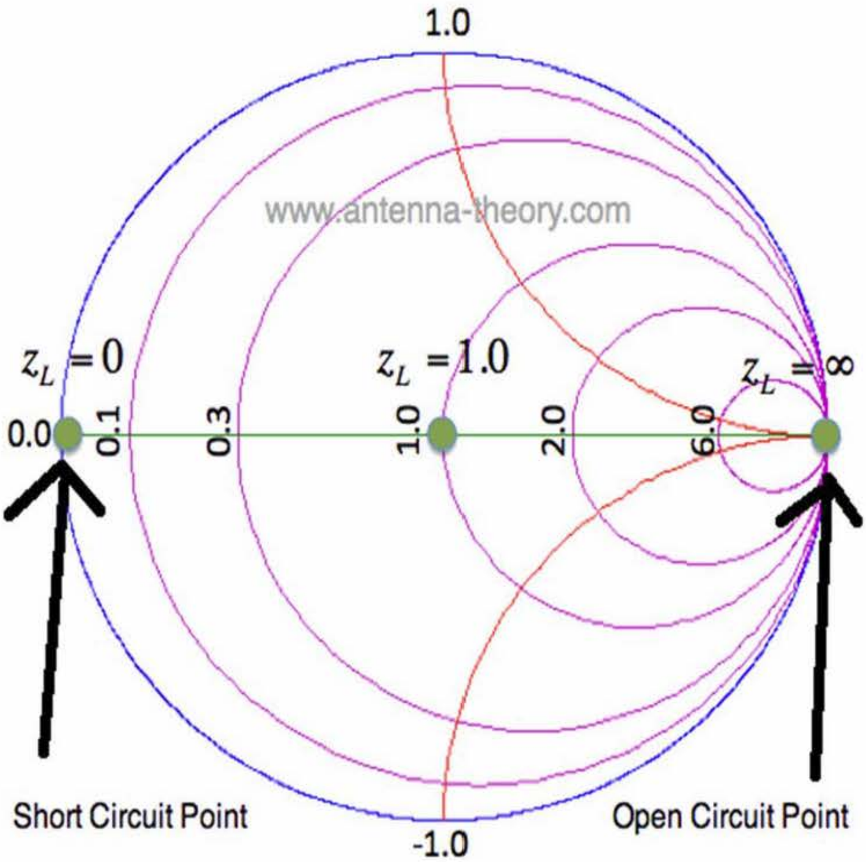


centre line represents **constant Resistance**. Along this line **the reactance is zero**, below this line **Capacitive Reactance** is present and above this line, **Inductive Reactance** is present.

The centre represents a perfect **50ohm resistive load** attached to the transmission line. The extreme **LEFT** position shown by a green dot, represents a **short** circuit (zero resistance) at the end of the transmission line whilst the extreme **right** position represents an **open** circuit (infinite resistance).

TRY THIS: After you perform a **calibration** on your NanoVNA and then have nothing connected to port 1: you should see a small coloured triangle sitting above the right-hand position. If so, you are being informed on the screen that your NanoVNA is correctly reading a zero-ohm resistance on port 1.

Step 2: Attach your "Short" sma connector to port 1 and what should you see?

yes!... the triangle appears exactly over the extreme left position to indicate that a short circuit has occurred at port1.

Step 3: Now take your 50ohm load sma connector and attach it to port 1. what do you expect to see?

If you have calibrated your NanoVNA correctly, the little colored triangle should appear exactly over the centre position.

The outer circle If you start at the extreme left-hand side at point 0.0, and travel around the circumference clockwise, you are indicating rf wave travelling toward the rf generator (transceiver). When you reach the extreme RHS at the "open spot" you have travelled one quarter of a wavelength. Continuing in the clockwise direction down the lower half of the circle you have travelled one half wavelength and arrive at the "short" position again. This outer circle is labeled in fractions of a wavelength.

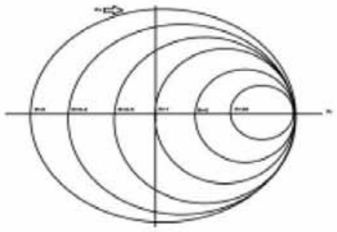
The outer circle of the Smith Chart is where the magnitude of the COMPLEX REFLECTION COEFFICIENT (Γ) is equal to 1. Along this curve, all of the power is reflected by the load impedance.

The **centre point** of the Smith Chart is where the COMPLEX REFLECTION COEFFICIENT (Γ) is equal to 0 (ZERO), it is the ONLY point on the entire Smith Chart where the characteristic impedance of the transmission line exactly matches the LOAD IMPEDANCE and the transmitter sees a "perfect match", ***NO PART OF THE TRANSMITTED RF SIGNAL IS REFLECTED BACK toward the transmitter: VSWR = 1***

** Note: the centre point normally is taken as 50 ohms but the Smith Chart is useful for any impedance not just 50 ohms.*

Types of Smith Charts

Smith chart is plotted on the complex reflection coefficient plane in two dimensions and is scaled in **normalized impedance** (the most common), **normalized admittance** or both, using different colour's to distinguish between them and serving as a means to categorize them into different types. Based on this scaling, smith charts can be categorized into three different types;



1. The Impedance Smith Chart (Z Charts)
2. The Admittance Smith Chart (YCharts)
3. The Immittance Smith Chart. (YZ Charts)

We shall concentrate on the **impedance smith charts**; they all have their "superpowers but let's not get too involved.

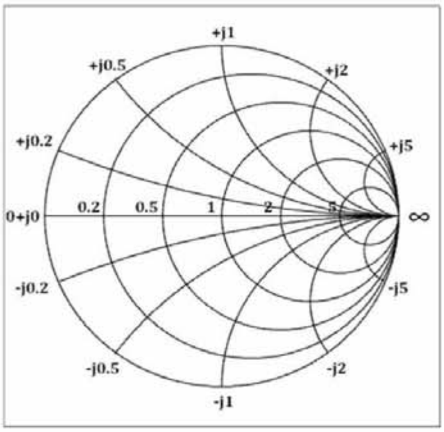
$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{z_L - 1}{z_L + 1}$$

for the Mathematicians Ref'Coeff can be calculated with Z_0 as Characteristic impedance and Z_L as Load impedance.

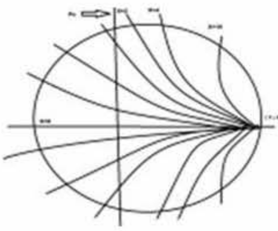
What are the squillions of circles for?

1. The Constant R Circles

The first set of lines referred to as **Constant Resistance lines form circles,** all tangent to each other at the right hand of horizontal diameter. The constant R Circles are essentially what you get when the Resistance part of the Impedance is held constant, while the value of X varies. As such, all the points on a particular Constant R circle represent the same resistance value(Fixed Resistance) . The value of the resistance represented by each Constant R Circle is marked on the horizontal line, at the point where the circle intersects with it. It is usually given by the diameter of the circle.



2. The Constant X Circles



The Constant X Circles are more of arcs than circles and are all tangent to each other on the right-hand extreme of horizontal diameter. They are generated when the impedance has a fixed **reactance** but a varying value of **resistance**.

The lines in the upper half represent positive reactance's while those in the lower half represent negative reactance's.

In solving problems around matching, the smith chart is used to **determine the value of the component** (capacitor or inductor) to use to ensure the line is perfectly matched, that is, ensuring the reflection coefficient is zero.

For example, Let's assume an impedance of Z = 0.5 - 0.6j. The first task to do will be to find the 0.5 constant resistance circle on the smith chart. Since the impedance has a negative complex value, implying a capacitive impedance, you will need to move counter-clockwise along the 0.5 resistance circle to find the point where it hits the -0.6 constant reactance arc (if it were a positive complex value, it would represent an inductor and you would move clockwise).This then gives an idea of the value of the components to use to match the load to the line.

Without getting too involved, a word about NORMALISED Z_0

Normalized scaling allows the Smith chart to be used for problems involving any characteristic or system impedance, which is represented by the center point of the chart. For Impedance smith charts, the most commonly used normalization impedance is 50 ohms and it opens the graph up making tracing the impedance easier. Once an answer is obtained through the graphical constructions described above, it is straightforward to convert between **normalized impedance** (or normalized admittance) and the corresponding unnormalized value by multiplying by the **characteristic impedance** (admittance). Reflection coefficients can be read directly from the chart as they are unit-less parameters.

Also, the value of impedances and admittances change with frequency and the complexity of problems involving them increases with frequency. Smith charts can however be used to solve these problems, one frequency at a time or over multiple frequencies.

When solving the problem manually with one frequency at a time, the result is usually represented by a point on the chart. While these are sometimes

“enough” for narrow bandwidth applications, it is usually a difficult approach for application with Wide Bandwidth involving several frequencies. As such the smith Chart is applied over a wide range of frequencies and the result is represented as a **Locus** (connecting several points) rather than a single point, provided the frequencies are close.

Great thing about the NanoVNA is that you don't really need to dwell on this stuff... it does all the hard work for you... your job is to read it and understand what it is telling you.

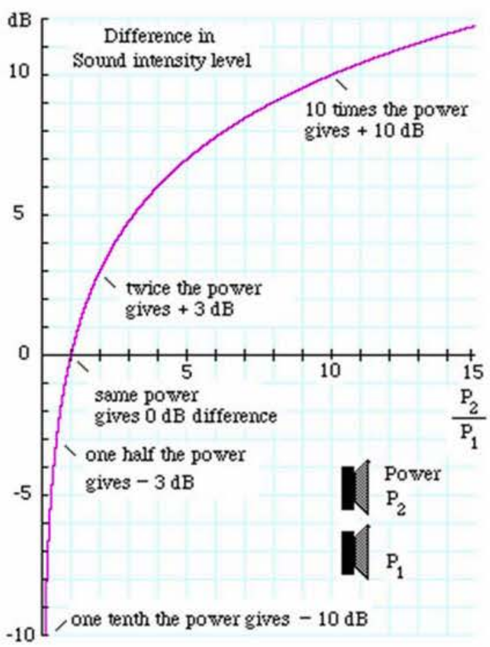
This paper is really intended to be just a reference guide to remind or reinforce our understanding of the many parameters which can be confusing and even slip from one's memory because we do not use these tools every day!

Some other useful facts:

dB: What is a decibel?

Decibels: dB, dB(A), dBA, dB(C), dBV, dBm and dBi? What are they all? How are they related to loudness, to phones and to sones? And how loud is loud?

AND... what about **RF frequencies**?



When Alexander G. B. *played with this he initially worked in audio, telephones etc. and the decibel arose as a measure (the BEL being rather large) It has become a very useful comparative measure when very large differences in parameters are involved.*

Example: in ideal quiet conditions, a young person can hear a 1 kHz tone at 0 dB emitted by a loudspeaker (perhaps a soft speaker?), by how much must the power of the loudspeaker be increased to raise the sound to 110 dB (a dangerously loud but survivable level)?

The difference in decibels between the two signals of power P_2 and P_1 is defined above to be

$\Delta L = 10 \log (P_2/P_1)$ dB so, raising 10 to the power of these two equal quantities:
$10^{L/10} = P_2/P_1$ so:
$P_2/P_1 = 10^{110/10} = 10^{11} =$ **one hundred thousand million**.

which is a demonstration that the human ear has a remarkably large dynamic range, perhaps greater than that of the eye.

Because the dB is a RATIO, i.e.: the difference between two of the same type of parameter, it DOES NOT HAVE UNITS ATTACHED TO IT.

example: "my transceiver puts out 20dB" is a meaningless statement... it is wrong!... it tells you nothing unless you could use it as a comparison*... such as: "My transceiver puts out 20dB MORE power than my mate's transceiver"*

since: dB = 10Log_{10} P1/P2

then: 20dB = 10Log_{10}P1/P2divide both sides by 10

2 = $\log_{10}$P1/P2 look up antilog of 2 = 100.... (10^2)

100 = P1/P2

i.e.: My transceiver puts out 100 times the power of my mate's transceiver

SO: 20db = 100 times power increase. -20dB = 100-fold decrease in power

if my friend puts out a maximum 100 watts then mine would put out 10,000 watts but of course that is absurd because in Australia we (being untrustworthy little children) we cannot use any more than 400 watts PEP because we are not like the rest of the world?

+ or - dB	Power ratio	Approx Power increase or (decrease) (Times)	Voltage Ratio approximate	To calculate dB 1/. For power ratios:
1	1:1	1	1.2	dB = $10\text{Log}_{10}P_1/P_2$

2	1.59:1	1.6	1.3
3	1.995:1	2	1.4
4	2.512:1	2.5	1.6
5	3.162:1	3	1.8
6	3.981:1	4	2
7	5.012:1	5	2.2
8	6.309:1	6	2.5
9	7.943:1	8	2.8
10	10	10	3
15	31.622:1	32	5.6
20	100	100	10
25	316.23:1	316	18
30	1000	1000	32
35	3162.3	3162	56
40	10,000	10,000	100
45	31,622.7	31,623	178
50	100,000	100,000	316
60	1,000,000	1,000,000	1000
70	10,000,000	10,000,000	3162
80	100,000,000	100,000,000	10,000

If P1 is greater than P2 then the dB result will be a positive value (ratio)
If P1 is less than P2 the dB result will be a negative value (ratio)

2./ For Voltage ratios

$$dB = 20\log_{10} V_1/V_2$$

or

$$10^{dB}/20 = V_1/V_2$$

Decibel abbreviation	Meaning / usage
dBA	"A" weighted sound pressure or sound intensity measurement.
dBc	Level of a signal with reference to the carrier being measured - normally used for giving the levels of spurious emissions and noise
dBd	Gain of an antenna with reference to a half wave dipole in free space
dBFS	Level with reference to full scale reading
dBi	Gain of an antenna with reference to an isotropic source, i.e., one that radiations equally in all directions.
dBm	Power level with reference to 1 mW
dBV	Level with reference to 1 volt
dBμV	Level with reference to 1 microvolt
dBW	Power level with reference to 1 watt

dBm to dBW & watts chart

The chart below gives a tabulation of dBm to dBW and watts which can be useful in determining some quick rough estimates of the values of power in different formats.

dBm	dBW	Watts	Terminology	Using indices
+100	+70	10 000 000	10 Megawatts	10^7 watts
+90	+60	1 000 000	1 Megawatt	10^6 watts
+80	+50	100 000	100 kilowatts	10^5 watts
+70	+40	10 000	10 kilowatts	10^4 watts
+60	+30	1 000	1 kilowatt	10^3 watts
+50	+20	100	100 watts	10^2 watts
+40	+10	10	10 watts	10 watts
+30	0	1	1 watt	10^{-1} watts
+20	-10	0.1	100 milliwatts	10^{-2} watts
+10	-20	0.01	10 milliwatts	10^{-2} watts
0	-30	0.001	1 milliwatt	10^{-3} watts
-10	-40	0.0001	100 microwatts	10^{-4} watts

-20	-50	0.00001	10 microwatts	10^{-5} watts
-30	-60	0.000001	1 microwatt	10^{-6} watts
-40	-70	0.0000001	100 nanowatts	10^{-7} watts
-50	-80	0.00000001	10 nanowatts	10^{-8} watts
-60	-90	0.000000001	1 nanowatt	10^{-9} watts

We acknowledge the input from various WEB Sites, Authors and manuals including those but not exclusively by W2AEW and strongly suggest if you wish to learn about Vector Network Analyzers and their use you visit his WEB Site W2AEW, there are more than 300 videos on that site.

Note: Sorry about the American spelling, word processor corrections!

FISH ON DRUGS

Trout enjoy water that contains methamphetamine – could this lead to them loitering around sewage pipes?

Around 269 million people worldwide use drugs each year. Often forgotten in this story is a problem of basic biology. What goes in must come out. Sewers are inundated with drugs that are excreted from the body, along with the broken down chemical components that have similar effects to the drugs themselves.

Sewage treatment plants don't filter these things out – they were never designed for it.
A lot of sewage also finds its way into rivers and coastal waters untreated. Once in the environment, drugs and their by products can affect wildlife. In a recent study published in the Journal of Experimental Biology, researchers in the Czech Republic investigated how methamphetamine – a stimulant with a growing number of users worldwide – might be affecting wild brown trout.

They examined whether concentrations of methamphetamine and one of it's by products, amphetamine, which were estimated from other studies that have measured illicit drug concentrations in waterways, could be detected in the brains of brown trout. They also looked at whether these concentrations were enough to cause the animals to become addicted.

The trout were exposed to the drug in large tanks over eight weeks and then put into withdrawal, going "cold turkey" in drug-free tanks for 10 days. During that time, the researchers tested the fish's preference for fresh water or water containing methamphetamine and compared this with the responses of fish that had never been exposed to the drug.

Their findings were intriguing. The methamphetamine-exposed fish preferred the water containing the drug, while no such preference was shown for the untreated fish. The researchers also found that during their withdrawal period, the methamphetamine-exposed trout moved less. The researchers interpreted this as a sign of anxiety or stress – typical signs of drug withdrawal in humans.

The brain chemistry of the exposed fish differed from the unexposed, too, with several changes in brain chemicals detected that correspond to what is seen in cases of human addiction. Even after the behavioural effects had waned after 10 days of withdrawal, these markers in the brain were still present. This suggests that methamphetamine exposure could have long-lasting effects, similar to what is seen in people.

Why should we care if trout are becoming addicted to drugs? There are several reasons.

If the trout are "enjoying" the drugs, as they appear to be in the recent study, they may be inclined to hang around pipes where effluent is discharged. Fish can behave similarly to what is seen in humans suffering from addiction, not only from this trial, but from several studies on different fish species. One of the hallmarks of drug addiction is a loss of interest in other activities – even those that are usually highly motivated, such as eating or reproducing. It's possible that the fish might start to change their natural behaviour, causing problems with their feeding, breeding and, ultimately, their survival. They may, for instance, be less likely to evade predators.

Exposure to drugs not only affects the fish themselves, but their offspring. In fish, addiction can be inherited over several generations. This could have long-lasting implications for ecosystems, even if the problem was fixed now.

This is not the first study to find illicit drugs in wildlife. In 2019, scientists in the UK reported cocaine in freshwater shrimp in all 15 rivers they sampled. Interestingly, they detected illicit drugs more often than some common pharmaceuticals.

But the wider effects of those drugs remain largely unknown. There have, however, been comprehensive studies into the effects of pharmaceuticals in rivers.

Medicines do not fully break down in our bodies either and arrive at wastewater treatment plants in faeces and urine. Most are discharged with wastewater effluent, but some enter rivers by seeping from landfills or farm fields where human sewage is used as fertiliser. Wildlife living in rivers and coastal waters where effluent is discharged are exposed to cocktails of medicines, from painkillers to antidepressants.

Caged fish downstream of some water treatment plants changed sex from male to female within a few weeks due to exposure to hormone-disrupting chemicals found in contraceptive pills. Recent studies have shown that antidepressants can cause a wide range of behavioural changes in aquatic organisms from aggression, attraction to light and increasing boldness.

Drug addiction is a global health concern that can devastate communities, and tackling its environmental consequences will be expensive. One study has estimated it would cost over $50bn to upgrade wastewater treatment plants in England and Wales so that they can remove these chemicals.

It might seem obvious that prescribed and illegal drugs designed to change behaviour in humans also change the behaviour of wildlife. But this problem is potentially far more widespread and complex. We don't even know if synthetic chemicals in everyday household products, such as cosmetics, clothes and cleaning agents, can affect the behaviour of people and other species. An international group of scientists has urged companies and regulating bodies to check their toxic effect on behaviour as part of risk assessments of new chemicals.

If we want to get to grips with the amount of pharmaceuticals in our waterways, more should be done to improve filtration in sewage treatment plants, and to force water companies to take more responsibility for ensuring effluent doesn't affect wildlife.

~Internet

“MDZhB” has been broadcasting since 1982. No one knows why

In the middle of a Russian swampland, not far from the city of St Petersburg, is a rectangular iron gate. Beyond its rusted bars is a collection of radio towers, abandoned buildings and power lines bordered by a dry-stone wall. This sinister location is the focus of a mystery which stretches back to the height of the Cold War.

It is thought to be the headquarters of a radio station, “MDZhB”, that no-one has ever claimed to run. Twenty-four hours a day, seven days a week, for the last three-and-a-half decades, it’s been broadcasting a dull, monotonous tone. Every few seconds it’s joined by a second sound, like some ghostly ship sounding its foghorn. Then the drone continues.

Once or twice a week, a man or woman will read out some words in Russian, such as “dinghy” or “farming specialist”. And that’s it. Anyone, anywhere in the world can listen in, simply by tuning a radio to the frequency 4625 kHz.

It’s so enigmatic, it’s as if it was designed with conspiracy theorists in mind. Today the station has an online following numbering in the tens of thousands, who know it affectionately as “the Buzzer”. It joins two similar mystery stations, “the Pip” and the “Squeaky Wheel”. As their fans readily admit themselves, they have absolutely no idea what they are listening to.

In fact, no-one does. “There’s absolutely no information in the signal,” says David Stupples, an expert in signals intelligence from City University, London.

What’s going on?

The frequency is thought to belong to the Russian military, though they’ve never actually admitted this. It first began broadcasting at the close of the Cold War, when communism was in decline. Today it’s transmitted from two locations – the St Petersburg site and a location near Moscow. Bizarrely, after the collapse of the Soviet Union, rather than shutting down, the station’s activity sharply increased.

There’s no shortage of theories to explain what the Buzzer might be for – ranging from keeping in touch with submarines to communing with aliens. One such idea is that it’s acting as a “Dead Hand” signal; in the event Russia is hit by a nuclear attack, the drone will stop and automatically trigger retaliation. No questions asked, just total nuclear obliteration on both sides.

There are clues in the signal itself

This may not be as wacky as it sounds. The system was originally pioneered in the Soviet era, where it took the form of a computer system which scanned the airwaves for signs of life or nuclear fallout. Alarmingly, many experts believe it may still be in use. As Russian president Vladimir Putin pointed out himself earlier this year, “nobody would survive” a nuclear war between Russia and the United States. Could the Buzzer be warding one off?

As it happens, there are clues in the signal itself. Like all international radio, the Buzzer operates at a relatively low frequency known as “shortwave”. This means that – compared to local radio, mobile phone and television signals – fewer waves pass through a single point every second. It also means they can travel a lot further.

While you’d be hard pressed to listen to a local station such as BBC Radio London in a neighbouring county, shortwave stations like the BBC World Service are aimed at audiences from Senegal to Singapore. Both stations are broadcast from the same building.

It’s all thanks to “skywaves”. Higher frequency radio signals can only travel in a straight line, eventually becoming lost as they bump into obstacles or reach the horizon. But shortwave frequencies have an extra trick –

they can bounce off charged particles in the upper atmosphere, allowing them to zig-zag between the earth and the sky and travel thousands, rather than tens, of miles.

Which brings us back to the Dead Hand theory. As you might expect, shortwave signals have proved extremely popular. Today they're used by ships, aircraft and the military to send messages across continents, oceans and mountain ranges. But there's a catch.

The lofty layer isn't so much a flat mirror, but a wave, which undulates like the surface of the ocean. During the day it moves steadily higher, while at night, it creeps down towards the Earth. If you want to absolutely guarantee that your station can be heard on the other side of the planet – and if you're using it as a cue for nuclear war, you probably do – it's important to change the frequency depending on the time of day, to catch up. The BBC World Service already does this. The Buzzer doesn't.

Another idea is that the radio station exists to "sound" out how far away the layer of charged particles is. "To get good results from the radar systems the Russians use to spot missiles, you need to know this," says Stupples. The longer the signal takes to get up into the sky and down again, the higher it must be.

There is a station with some striking similarities
Alas, that can't be it either. To analyse the layer's altitude the signal would usually have a certain sound, like a car alarm going off – the result of varying the waves to get them just right. "They sound nothing like the Buzzer," says Stupples.

Intriguingly, there is a station with some striking similarities. The "Lincolnshire Poacher" ran from the mid-1970s to 2008. Just like the Buzzer, it could be heard on the other side of the planet. Just like the Buzzer, it emanated from an undisclosed location, thought to be somewhere in Cyprus. And just like the Buzzer, its transmissions were just plain creepy.

At the beginning of every hour, the station would play the first two bars of an English folk tune, the Lincolnshire Poacher.

"Oh 'tis my delight on a shining night

In the season of the year

When I was bound apprentice in famous Lincolnshire

'Twas well I served my master for nigh on seven years…"

After repeating this 12 times, it would move on to messages read by the disembodied voice of a woman reading groups of five numbers – "1-2-0-3-6" – in a clipped, upper-class English accent.

To get to grips with what was going on, it helps to go back to the 1920s. The All-Russian Co-operative Society (Arcos) was an important trade body, responsible for overseeing transactions between the UK and the early Soviet Union. Or at least, that's what they said they did.

In May 1927, years after a British secret agent caught an employee sneaking into a communist news office in London, police officers stormed the Arcos building. The basement had been rigged with anti-intruder devices and they discovered a secret room with no door handle, in which workers were hurriedly burning documents.

It may have been dramatic, but the British didn't discover anything that they didn't already know. Instead the raid was a wake-up call to the Soviets, who discovered that MI5 had been listening in on them for years.

“This was a blunder of the very first order,” says Anthony Glees, who directs the Centre for Security and Intelligence Studies at the University of Buckingham. To justify the raid, the prime minister had even read out some of the deciphered telegrams in the House of Commons.

The upshot was that the Russians completely reinvented the way messages are encrypted. Almost overnight, they switched to “one-time pads”. In this system, a random key is generated by the person sending the message and shared only with the person receiving it. As long as the key really is perfectly random, the code cannot be cracked. There was no longer any need to worry about who could hear their messages.

Enter the “numbers stations” – radio stations that broadcast coded messages to spies all over the world. Soon even the British were doing it: if you can’t beat them, join ‘em, as they say. It’s quite difficult to generate a completely random number because a system for doing so will, by its very nature, be predictable – exactly what you’re trying to avoid. Instead officers in London found an ingenious solution.

They’d hang a microphone out of the window on Oxford Street and record the traffic. “There might be a bus beeping at the same time as a policeman shouting. The sound is unique, it will never happen again,” says Stupples. Then they’d convert this into a random code.

Of course, that didn’t stop people trying to break them. During World War Two, the British realised that they could, in fact, decipher the messages – but they’d have to get their hands on the one-time pad that was used to encrypt them. “We discovered that the Russians used the out-of-date sheets of one-time pads as substitute toilet paper in Russian army hospitals in East Germany,” says Glees. Needless to say, British intelligence officers soon found themselves rifling through the contents of Soviet latrines.

Now North Korea are getting in on the act, too
The new channel of communication was so useful, it didn’t take long before the numbers stations had popped up all over the world. There was the colourfully named “Nancy Adam Susan”, “Russian Counting Man” and “Cherry Ripe” – the Lincolnshire Poacher’s sister station, which also contained bars of an English folk song. In name at least, the Buzzer fits right in.

It also fits with a series of arrests across the United States back in 2010. The FBI announced that it had broken up a “long term, deep cover” network of Russian agents, who were said to have received their instructions via coded messages on shortwave radio – specifically 7887 kHz.

Now North Korea are getting in on the act, too. On 14 April 2017, the broadcaster at Radio Pyongyang began: “I’m giving review works in elementary information technology lessons of the remote education university for No 27 expedition agents.” This ill-concealed military message was followed by a series of page numbers – No 69 on page 823, page 957 – which look a lot like code.

It may come as a surprise that numbers stations are still in use – but they hold one major advantage. Though it’s possible to guess who is broadcasting, anyone can listen to the messages – so you don’t know who they are being sent to. Mobile phones and the internet may be quicker, but open a text or email from a known intelligence agency and you could be rumbled.

It only becomes a numbers station in moments of crisis, such as if Russia were invaded
It’s a compelling idea: the Buzzer has been hiding in plain sight, instructing a network of illicit Russian spies all over the world. There’s just one problem. The Buzzer never broadcasts any numbered messages.

This doesn’t strictly matter, since one-time pads can be used to translate anything – from code words to garbled speech. “If this phone call was encrypted you’d hear “…enejekdhejenw…’ but then it would come out the other side sounding like normal speech,” says Stupples. But this would leave traces in the signal.

To send information over the radio, essentially all you're doing is varying the height or spacing of the waves being transmitted. For example, two low waves in a row means x, or three waves closer together means y. When a signal is carrying information, instead of neat, evenly spaced waves like ripples on the ocean, you're left with a wave like the jagged silhouette of an ECG.

This isn't the Buzzer. Instead, many believe that the station is a hybrid of two things. The constant drone is just a marker, saying "this frequency is mine, this frequency is mine…" to stop people from using it.

It only becomes a numbers station in moments of crisis, such as if Russia were invaded. Then it would function as a way to instruct their worldwide spy network and military forces on standby in remote areas. After all, this is a country around 70 times the size of the UK.

It seems they're already been practicing. "In 2013 they issued a special message, 'COMMAND 135 ISSUED' that was said to be test message for full combat readiness," says Māris Goldmanis, a radio enthusiast who listens to the station from his home in the Baltic States.

The mystery of the Russian radio may have been solved. But if its fans are right, let's just hope that drone never stops.

~Internet

A new callsign lookup website is online https://vklookup.info/#vk

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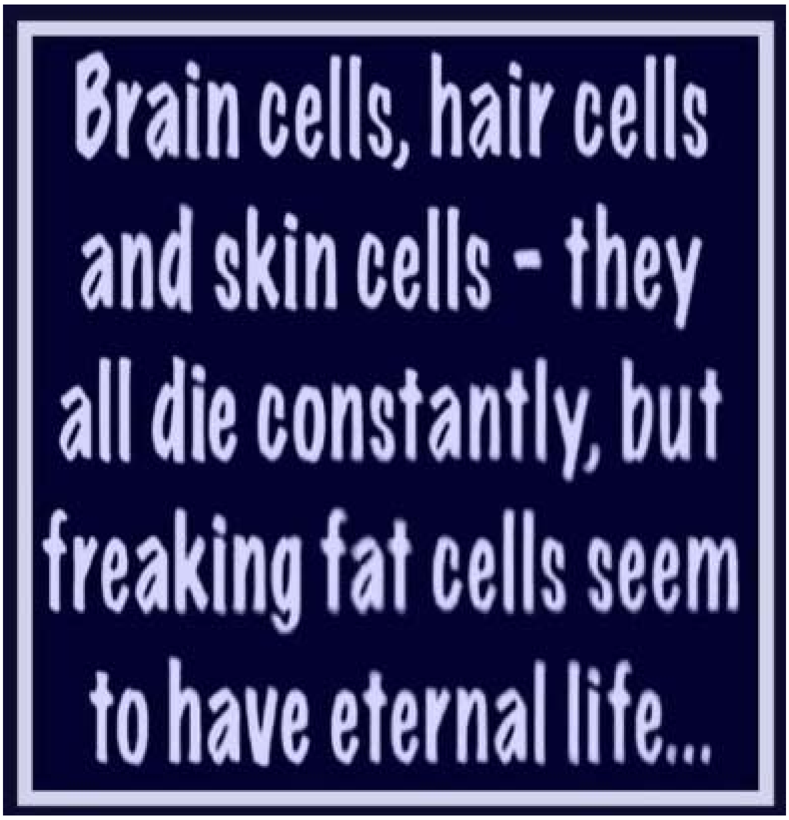
The kids won't move back home if they can't find it.


The official sports drink when I was a kid..

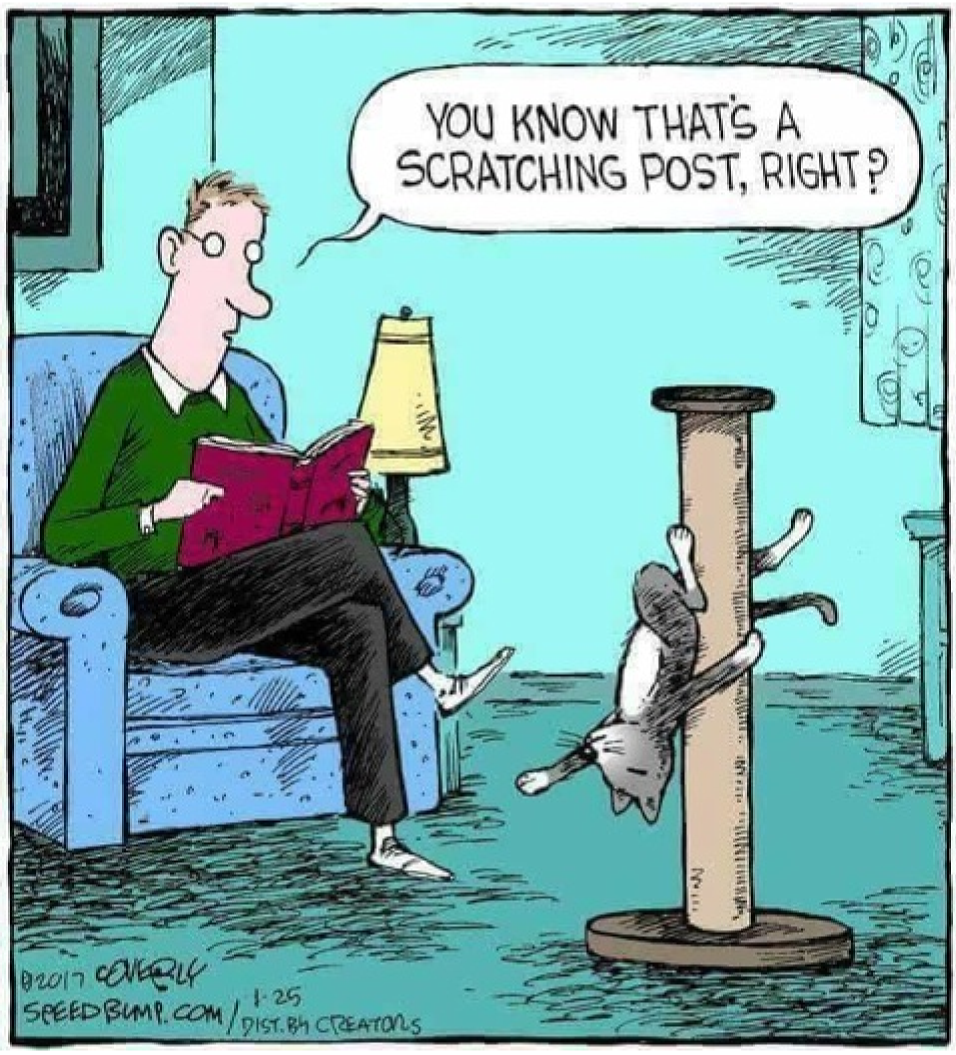

Brain cells, hair cells and skin cells - they all die constantly, but freaking fat cells seem to have eternal life...


How to keep all the cookies to yourself:


ATTENTION!
DON'T WEAR
HEADPHONES WHILE
VACUUMING!
I've just finished the
whole house and realized
the vacuum wasn't even
plugged in.


Before 2020, we were pretty
wild! Remember how we all used
to eat cake after someone had
blown on it? Crazy times!


Red Squirrels
Drive slowly
To be honest, I'm surprised they can drive at all.


YOU KNOW THAT'S A SCRATCHING POST, RIGHT?


FOR AN ADDITIONAL
$4.95 WE WILL
PROVIDE A RECEIPT
THAT MATCHES
WHAT YOU TOLD
YOUR SPOUSE YOU
PAID.


Let's all take a moment to appreciate the time and effort this guy spent putting a strap on his dirt so it wouldn't fall off.

Australia Ham Radio 40 Meter Net

7 Days a Week

10am Local time

(East coast)

7.097 MHz LSB

Approximately + or – QRM

Hosted by Ron VK3AHR

NEVARC 2 Meter Net

VK2RWD

Wednesday - 8.00pm

Local time

President, VK3VS, Matt
Vice President, VK2VU, Gary
Secretary, VK2BFC, Frank
Treasurer, Amy Bilston

NEVARC CLUB PROFILE

History
The North East Victoria Amateur Radio Club (NEVARC) formed in 2014.
As of the 7th August 2014, Incorporated, Registered Incorporation number A0061589C.
NEVARC is an affiliated club of the Wireless Institute of Australia and The Radio Amateur Society of Australia Inc.

Meetings
Meetings details are on the club website, the Second Sunday of every month, check for latest scheduled details.
Meetings held at the Belviour Guides Hall, 6 Silva Drive West Wodonga.
Meetings commence with a BBQ (with a donation tin for meat) at 12pm with meeting afterwards.
Members are encouraged to turn up a little earlier for clubroom maintenance.
Call in Via VK3RWO, 146.975, 123 Hz tone.

NEVARC NETS

HF
7.097 MHz 7 Days a Week - 10am Local time

VHF
VK2RWD Wednesday - 8.00pm Local time

Benefits
To provide the opportunity for Amateur Radio Operators and Short Wave Listeners to enhance their hobby through interaction with other Amateur Radio Operators and Short Wave Listeners. Free technology and related presentations, sponsored construction activities, discounted (and sometimes free) equipment, network of likeminded radio and electronics enthusiasts. Excellent club facilities and environment, ample car parking.

Website: **www.nevarc.org.au**

Facebook: **www.facebook.com/nevicARC/**

Postal: **NEVARC Secretary**
PO Box 8006
Birallee Park
Wodonga Vic 3690

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Any dates, times and locations given for upcoming events please check with a reliable source closer to the event.
This is particularly true for pre-planned outdoor activities affected by adverse weather etc.
The club website http://nevarc.org.au/has current information on planned events and scheduled meeting dates.
You can get the WIA News sent to your inbox each week by simply clicking a link and entering your email address found at www.wia.org.au The links for either text email or MP3 voice files are there as well as Podcasts and Twitter. This WIA service is FREE.